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A CRITICISM OF THE "FAUNAL RELATIONSHIPS OF THE MEGANOS GROUP" BY BRUCE L. CLARK

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In a recent paper¹ published in the *Journal of Geology* Dr. Bruce L. Clark revises the Eocene scale of California by introducing a new division, the Meganos group, by cutting off the lower portion of the strata which had previously been referred to the lower Tejon. Clark's essential basis for division is stratigraphy first recognized in the area north of Mount Diablo, Contra Costa County. After his recognition of an unconformity in this area, subsequent faunal work led him to assert a marked faunal break as well although he recognized that the fauna obtained from these beds "appears to be more closely related to the Tejon than to the Martinez." In this paper Clark deals with the general correlation of the middle and upper Eocene Sections of the Pacific Coast and he tentatively correlates his Meganos group with the Wilcox of the Gulf Coast.

Owing to his absence from the United States, the writer is unable to discuss this paper in detail, but there are certain general conclusions of Dr. Clark's to which he wishes to record a firm dissent.

The evaluation of an unconformity is frequently a difficult matter and in many cases only a close study of the faunas from above and below the line of unconformity will enable the paleontologist to determine the relative value of the time break recorded in the rocks. Now the recognition of the existence of unconformities within the Tejon Group is not new, and largely upon this account the writer has consistently clung to the term *group* in describing the Tejon as a stratigraphic and faunal unit. In making a study of the Tejon Group, its probable future division

¹ Bruce L. Clark, "The Stratigraphic and Faunal Relationships of the Meganos Group, Middle Eocene of California," *Jour. Geol.*, Vol. XXIX (1921), pp. 125-65.



FIG. 1.—Outline map of California showing (1) Mount Diablo region; (2) region north of Coalinga; (3) south end of San Joaquin Valley; (4) Camulos quadrangle; (5) Table Mountain, in the vicinity of Oroville.

into formations was constantly kept in mind. In the special case in point the writer regards the unconformity north of Mount Diablo as being such a one as would separate the Tejon group into formations, while Dr. Clark would make two groups. Dr. Clark admits that this unconformity was not stratigraphically recognized in the fine Tejon-Eocene section only a few miles distant on the south side of Mount Diablo.

Detailed mapping has failed to show any marked difference in dip and strike between the Meganos and the Tejon in this southern area, such as occurs to the north of the mountain (Mount Diablo). At a few localities there is an apparent difference in dip between the beds of the two horizons; this, however, could not be verified with certainty, the division being recognized by a sharp change in lithology, and by faunal evidence [p. 141].

The footnote on this same page is likewise significant:

In the former paper ["Meganos Group, a Newly Recognized Division in the Eocene of California," *Bull. Geol. Soc. America*, Vol. XXXIX (1918), pp. 281-96] referred to above, the writer stated that in this section there is a marked difference in strike between the Meganos beds and those of the Tejon, and the difference was taken as one of the evidences of unconformity between the beds of these two horizons. Later work, however, has shown that this apparent difference in strike is, in part at least, the result of faulting. Also it was stated that to the east of this area the Meganos disappeared due to this unconformity. At that time the writer had not recognized that the so-called Tejon beds to the east, as described by Dickerson, were in part Meganos.

Concerning the presence of unconformities in other parts of California, Clark refers to his studies made in the vicinity of Coalinga and Simi Hills, Ventura County, as follows:

The results of this work show conclusively that beds of both Meganos and Tejon age are present in all of these areas, and that there is in each an unconformity separating the strata of those two series.¹ . . . As seen between . . . Domengine Creek and Cantua Creek (Coalinga Quadrangle), the upper beds of the Meganos consist of a white sandstone which was mapped by Anderson and Pack as a part of the Tejon. The contact between the Meganos and Tejon comes in between this sandstone and somewhat similar sandstones of the Tejon. It is, as a rule, marked by a conglomerate and is irregular at numerous localities. The sandstones below the contact, due to the unconformity, thicken and thin very noticeably along the strike. Also, at a number of localities the lower sandstones show a dip and strike appreciably different from those of the Tejon beds above. While these differences amount

¹ Evidently series is used loosely.

at the most to only a few degrees, it is sufficient to cause the lower sandstone layers to be cut off obliquely, and on the cliff sections they are seen to abut against the basal beds of the Tejon [pp. 143-45].

The writer cannot see how "the sandstones below the contact, *due to the unconformity* thicken and thin very noticeably along the strike" but rather thinks that the beds were deposited near shore and that the sandstone lenses into shale or the shale gradually grades into sandstone. If memory is correct, Anderson and Pack's mapping indicates that several comparatively thick members exhibit this same phenomenon on a great scale. Anderson and Pack, F. M. Anderson, Clarke Gester, and J. A. Taff had good opportunities to study this section and as far as I recall none of them recorded any notable dip differences. The writer did not do extended field work in this section, but from what was observed, he believes that careful search will bring to light several erosional unconformities in the region. That is, the Tejon group in this region was deposited under strictly littoral conditions, and from time to time comparatively slight emergences of the Eocene continental strand line are recorded by these erosional unconformities. Dr. Clark states that the lithology of the sandstones above and below this unconformity are essentially similar. This similarity is so close that a series of hand specimens from above would not be separable from a series from below if the two were mixed. Depositional conditions over the present sites of Simi Hills region and vicinity of Grapevine Canyon are characteristically littoral as indicated by both the fauna and the lithology.

The fauna of only fifteen species listed by Clark from San Emigdio Canyon on page 149 is entirely too meager upon which to base definite broad conclusions. Of these, eight are new species, one is only generically determined, two are doubtfully referred to described Eocene species. However, it is quite possible that the Turbinolia Zone of the Tejon Group (Meganos Group of Clark) may be present here.

Dr. Clark assigns the *Siphonalia sutterensis* Zone of Dickerson to his Meganos Group largely upon faunal grounds, since *Turritella merriami*, *Ancilla* (Oliverato) *californica*, and a few other forms are found at Oroville, Marysville Buttes, in the vicinity of Mount

Diablo, Camulos Quadrangle, and the Coalinga region. On pages 130 and 131 Clark states that

After discussing the various Eocene sections, reasons will be given for correlating the beds referred to the Meganos group in these different areas in the Coast ranges with one another and with the marine Ione formation in the Sierra Nevada foothills, as mapped and described by Lindgren and Turner *not, however, including the type section of the Ione.*¹

Why not discuss the type Ione? It is well described and at one locality has yielded a fair but determinable marine fauna containing *Turritella merriami* and other typical Tejon species. Also the strata of the type Ione clearly intergrade with the Tertiary Auriferous gravels of the Sierra Nevada foothills. Now the type Ione may be traced southward and connected with the Marine Eocene strata a half-mile south of Merced Falls where specimens of *Venericardia planicosta merriami* may be collected in abundance. Farther south, the stratigraphy of the Ione clearly demonstrates deposition by a sea transgressing from the west. North of the type section of the Ione, Lindgren and Turner have traced these beds through to Oroville. Dr. Clark in his historical review quotes from Dickerson's "Note on the Faunal Zones of the Tejon Group" as follows:

A study of the relationship between zone 3, Mount Diablo region, and the *Siphonalia sutterensis* zone and their geographic position suggest that the uppermost strata of the Marysville Buttes and Oroville were deposited by a transgressing sea, and that only in favored places along the western borders of the Sierra have the latest Eocene sediments been preserved from erosion. Lava caps such as that of the older Basalt of South Table Mountain have preserved these youngest Tejon sediments which have heretofore been regarded as Ione.

This quotation creates the impression in the reader's mind that Dickerson's concept of the Tejon-Ione relations was purely theoretical, whereas such is not the case. The stratigraphy of the Ione at Bear Creek 20 miles south of Merced Falls, at Merced Falls, at Ione, at Oroville, all clearly indicate deposition by a transgressing sea in close proximity to an old Eocene shore. Into this Eocene sea the streams of the low mountainous Eocene upland poured their golden sands. The reader is referred to Dickerson's paper, "Stratigraphy and Fauna of the Tejon Eocene of California," for a full

¹ Dickerson's italics.

discussion of these essential matters. Clark has evidently missed the significance of this evidence as he states on page 162 of his paper that

Dickerson attempted to establish the stratigraphic sequence of his upper faunal zone in relation to that of the typical Tejon indirectly, not having the two faunas in the same section. His idea that the *Siphonalia sutterensis* fauna is younger than that of the typical Tejon appears to have been founded principally upon what he considered evidence for different stages of evolution of certain pelcypods, such as *Venericardia planicosta merriami* Dickerson and *Cardium marysvillensis* Dickerson. He believed that the variety *merriami* was derived from the variety *hornii*. Later stratigraphic work has shown that these species occur in a sequence the reverse of that which Dickerson originally supposed, the *Venericardia planicosta merriami* coming in beds older than those containing the variety *hornii*. The same is true of the other species, which were derived from typical Tejon species.

It is true, however, that the problem of Ione-Tejon relations was attacked with faunal weapons as well. Clark states that "Later stratigraphic work has shown that these species occur in a sequence the reverse of that which Dickerson originally supposed. . . ."

In the historical review on page 129, Dr. Clark reviews a short paper, by Arnold and Hannibal, and includes the following quotation from it:

The writers have shown that in Oregon and Washington the Eocene may be divided into three faunal divisions, the Chehalis, Olequa, and Arago or Ione formations. The Chehalis formation is characterized especially by *Venericardia hornii* Gabb, *Meretrix californica*, *Pecten (Chlamys) landesi* or *Venericardia hornii* Gabb and a tropical flora, and the Arago or Ione formation by *Turritella merriami* Dickerson, a form of *V. hornii* with obsolete ribs (var. *aragonia* A. and H.), and a tropical flora.

The Arago or Ione beds represent a horizon younger than any Tejon recognized in the Tejon or Puget Basin. The Arago or Ione beds occurring as they do in basins distinct from those in which the Tejon series is developed, and being formed at a different period, must be treated as a distinct division of the Eocene.

¹ Arnold and Hannibal use formation as an equivalent for faunal zone or horizon and loosely use *formation, group, series*. The form referred to as *V. hornii* var. *aragonia* A. and H. was not described by them but was collected at the type locality of *V. planicosta merriami*, on Little River, Roseburg Quadrangle, Oregon. Arnold and Hannibal classed these beds as Arago (or Ione).

In connection with this statement Clark refers to Weaver's stratigraphic studies wherein Weaver shows that the Olequa and Chehalis of Arnold and Hannibal were reversed. Weaver's careful work cleared up this succession but apparently does not invalidate Arnold and Hannibal's assignment of the Arago as the uppermost formation of the Eocene. Arnold and Hannibal regard the type locality of *Venericardia planicosta merriami*, on Little River, Roseburg Quadrangle, Oregon, as being in the uppermost portion of the Eocene, their Arago formation, and in this general conclusion the writer is in agreement. The evidence yielded by evolutionary forms of *Venericardia planicosta* have not been sufficiently studied by Dr. Clark. The first of these forms is *V. planicosta venturaense* Waring and was described from the Martinez (Lower Eocene) of the Simi Hills, Ventura County, California. Waring's type was considerably eroded but a mature specimen collected from near the type locality by the writer shows strong V-shaped ribs marked by very prominent nodes. Now these characters are conspicuous only in the youthful stages of *V. planicosta hornii* Gabb, the nodose character disappearing rapidly as the specimen matures. In very youthful specimens of *V. planicosta merriami* the same characters appear but these forms upon reaching maturity are marked by nearly complete obsolescence of ribs as well.

Clark, in the writer's opinion, overemphasizes the presence of new species in the Eocene and permits this to color his views. It is the writer's experience that in California, where unusually good preservation is found, many new species will be discovered. We must not lose sight of the fact that the pelecypod and gastropod fauna of the Tejon group is probably not much more than half-described. And on this account we must not create new horizons, based largely on such evidence. Again, let us not forget that the Tejon group is largely composed of inshore or strictly littoral sediments, and that the lignite seams occurring commonly throughout California, Oregon, and Washington, generally indicate deposition in lakes or lagoons bordering the Eocene shore. Thus during the deposition of the upper Tejon north of Mount Diablo three different carbonaceous beds were laid down, and there is evidence to show that the sea was at least temporarily withdrawn while these lignitic

strata were being formed. In other words, minor unconformities are here present. Sixty miles east of Mount Diablo there is a ten-foot seam of coal at Ione in the type section. Now if Clark is right in correlating the Ione with his Meganos group, then the Meganos group is again broken by an unconformity, since several hundred feet of Eocene sediments underlie the Ione coal seam which rests unconformably upon them.

Along the foothills of the Sierra Nevada in the undisturbed, nearly horizontal Eocene beds many interesting data are yet to be secured, as here the old Eocene shore is traceable and the streams of the old Eocene peneplain are still preserved beneath thick lava for the inspection of some untiring geologist interested in reconstructing the past of this wonderful land.